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4P

FINAL REPORT:
NASA ROSAT grant NAG5–2094
ROSAT SPECTRA OF SYMBIOTIC NOVAE
and
ROSAT TARGET OF OPPORTUNITY: AG DRACONIS

Prof. Robert E. Stencel
Department of Physics
University of Denver
Denver, Colorado 80208

Report covering the period 1994 Mar.15 thru 1994 Sep.14

Original to:
Dr. Robert Petre
Code 666
NASA Goddard
Greenbelt, Md. 20771

One Copy to:
Grants Officer
Code 280
NASA Goddard
Greenbelt, Md. 20771

Two Copies to:
NASA Sci. Tech. Info. Facility
Attn: Accessioning Department
800 Elkridge Landing Road
Linthicum Heights, MD 21090

One Copy to:
Ms. Debbie Bradford
Program Support Services
University of Denver

and
DU/Physics Grant File 5-34106

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FINAL Report, NAG5-2094, Covering: 3/15/94 – 9/14/94

Principal Investigator: Prof. R.E.Stencel, University of Denver

Project Title:"ROSAT Spectra of Symbiotic Novae", and,
"ROSAT Target of Opportunity: AG Draconis".

OBJECTIVES:

The purposes of this grant included:
1. Acquisition of new PSPC observations of X-ray selected symbiotics, and determination of source spectral hardness and variations;
2. Monitoring the brightest X-ray symbiotic, AG Dra, for flaring.

The first study is expected to result in assessment of whether symbiotics as a class are soft X-ray sources, like the brightest member AG Dra. Analysis of the ROSAT sky-survey data (average effective exposure times of 200 seconds)suggests several symbiotics have significant, hard X-ray components in their spectra (Bickert, Stencel et al. 1993 AA in press). The planned, several thousand second observations should verify this with improved signal to noise spectra, and provide checking for rapid variations.

In the second study, we seek to monitor the brightest X-ray symbiotic, AG Draconis, which is a 554 day period binary that shows flare events every 10-15 years. The last such flare occurred in 1985, and recent IUE and Voyager observations will complement the ROSAT re-observations during 1992/93.

ACCOMPLISHMENTS UNDER THIS GRANT:

- Grant initiated at U of Denver, October 1992.
- ROSAT PSPC observations obtained [AO 2 and 3]:
  920616 AG Dra 1.9 ksec US201041P
  920920 AG Dra 1.6 ksec US201042P
  921216 AG Dra 1.3 ksec US201043P
  930105 Z And 9.9 ksec US300189P
  930316 AG Dra 1.7 ksec US201044P
  930329 RR Tel 2.3 ksec US300185P
  930330 AS 281 10.0 ksec US300188P
  930414 RX Pup 3.2 ksec US300187P
  930609 AG Peg 6.0 ksec US300186P
- All ROSAT data tapes have been received. Partial preliminary reductions done with software at Univ. Michigan/Astronomy during sabbatical, courtesy of Joel Bregman and students.

- Served on ROSAT AO4/galactic review panel, 4/93.
- New Sun workstation, contributed by DU, received 6/93 and being set up to work with ROSAT data formats and software. Problems with system support, and requested ROSAT IDL software still has not yet been received. Expect to be set up on internet by 6/94.
- Complementary IUE observations of AG Dra obtained 1992 Jul06, Sep12, Oct02, Dec03 and 1993 Feb27, Mar11, Apr09, May03 and May26. EG And IUE co-observations 930101 and 930115, HST co-observation 930204. Z And IUE co-observations 930101. RR Tel IUE co-observations May'93.
- Went to no cost extension status 10/93. Succeeded in obtaining additional IUE observing time for RIASS follow-up observations. Acquired CI Cyg spectra during 10/93.
- Initial analysis of data shows the following patterns:

Target	Obs Date	Time	cts/sec	log N_H	log T_e(RS)	Var?	HR1
AG Dra	6/6/92	1.9ks	0.6098	20.90	5.00	poss	−0.98
AG Dra	9/20/92	1.6ks	0.7760	20.25	5.78	poss	−1.00
AG Dra	12/16/92	1.3ks	0.7852	20.87	5.00	poss	−1.00
Z And	1/5/93	9.8ks	0.0016	-	-	-	0.34:
AG Dra	3/16/93	1.7ks	0.7282	20.31	5.77	poss	−5.12
RR Tel	3/29/93	2.3ks	0.2700	19.94	5.63	poss	−0.92
AS281	3/30/93	10.0ks	<0.003	-	-	-	-
RX Pup	4/14/93	3.2ks	0.0600	-	-	poss	0.99
AG Peg	6/9/93	6.0ks	0.0670	20.40	6.55	poss	0.55

Initial conclusions are that most x-ray symbiotics are likely variable on short timescales, few possess relatively harder photons (> 1 keV) and that AG Dra may have shown some intermediate timescale variation during the repeated observation period ("mini-flare" between 6/92 and 9/92?).

- Continuing efforts will need to further study these observations for evidence of variation in AG Dra (4 pointings) and for hardness ratio in additional 5 sources.
- The ROSAT report on Symbiotics, including both pointed and survey phase observations, was [resented at the summer AAS meeting, and June was spent revising the report in response to inquiries at the conference.
- Despite expiration of support, I hope to continue contacts with MPE collaborators over sky survey data analysis and serendipitous pointings relevant to this investigation, as time permits.

PUBLICATIONS CITING SUPPORT OF NAG5-2094:

"ROSAT Detections of Symbiotic Binaries"
K.Bickert and R.Stencel
1994 B.A.A.S. 26, 935.

"Spectral Hardness of Selected X-ray Symbiotics"
Stencel, Bickert, et al.
Ap.J., in preparation.

"Quiescent X-ray Variability of AG Draconis"
Stencel, Brown, Bickert et al.
Ap.J., in preparation.